The planetary protection strategy of the Earth Return Orbiter–Capture, Containment & Return System in the context of the Mars Sample Return campaign

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Abstract

The Mars Sample Return Campaign aims at bringing back to Earth the rock and atmospheric samples that the rover Perseverance has started to collect on the surface of Mars with the goal of analyzing them in a facility built specifically for this purpose to answer questions about the habitability of Mars. The Campaign consists of several missions, including the Earth Return Orbiter–Capture, Containment & Return System (ERO-CCRS), which will capture the samples previously put in Martian orbit, contain them in redundant containers to ensure that no unsterilized particles are released, and return them to Earth through a parachute-less entry vehicle. Both NASA and ESA policies address the United Nations' Outer Space Treaty by addressing potential harm from material returned from solar system bodies beyond the Earth-Moon system. In the conduct of Mars Sample Return, the two agencies have agreed to apply approaches consistent with their own standards to campaign elements each provides.
This work presents the overall strategy for both forward and backward planetary protection for the ERO-CCRS mission. Specifically, for forward planetary protection, CCRS is not required to meet specific bioburden requirements as a Category III mission provided the ERO (1) meets orbital lifetime requirements during orbiter operations and (2) any elements jettisoned at Mars meet orbital lifetime requirements. CCRS is required to be built in ISO-8 or better cleanrooms and, by agreement with ERO, be compatible with direct bioburden verification methods. For backward planetary protection, the overall approach includes building robust, highly reliable systems to prevent inadvertent release of unsterilized Mars material through redundant containment vessels and particle transport analyses. Ongoing work to define verification approaches and quantify containment assurance levels for specific sample return systems will also be discussed, along with how those data will inform launch approval for ERO-CCRS.